

AIRBORNE IN-SITU SPECTRAL CHARACTERIZATION AND CONCENTRATION
 ESTIMATES OF FLUORESCENT ORGANICS AS A FUNCTION OF DEPTH

by

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The primary purpose of many in-situ airborne light scattering experiments in natural waters is to spectrally characterize the subsurface fluorescent organics and estimate their relative concentrations. This is often done by shining a laser beam into the water and monitoring its subsurface return signal. To do this with the proper interpretation, depth must be taken into account. If one disregards depth dependence when taking such estimates, both their spectral characteristics and their concentrations estimates can be rather ambiguous.

Figure 1 is a sketch of a simple airborne lidar configuration that will detect the subsurface return signal $E(Z, \lambda)$ from a particular depth Z at the wavelength λ . While the configuration remains unchanged, the depth Z is varied by simply varying the height h of the aircraft. Note that by inspection, we see that

$$Z = [S - h \cdot (\tan A_a - \tan B_a)] / (\tan A_w - \tan B_w).$$

Now with some algebra, we will find

$$K(Z, \lambda_L) \cdot \sec B_w + K(Z, \lambda_f) \cdot \sec A_w = \frac{1}{\Delta Z} \ln \frac{(Z - \Delta Z)^2}{Z^2} \cdot \frac{E(Z - \Delta Z, \lambda_f)}{E(Z, \lambda_f)}$$

where $K(Z, \lambda_1)$ is the diffuse attenuation coefficient at the depth Z and the laser wavelength λ_1 , and where $K(Z, \lambda_f)$ is the diffuse attenuation coefficient at the depth Z and fluorescent

wavelength g_f . Both of these coefficients can be easily calculated.

Now it is well-known that the diffuse attenuation coefficient can be expressed as

$$K(Z, g) = C(z) \cdot f(g)$$

where $C(z)$ is the fluorescent organic concentration as a function of z , and $f(g)$ is the unique proportionality factor, which is equal to the absorptivity when very little scattering is involved, as a function of g . Hence, one easily sees that if we profile $K(z, g)$ as z varies, by analogy, we profile the concentration $C(z)$ as a function of depth.

It should be noted that the monitored collimated return signal beam width must be small compared to Z or else the measurements lose their meanings.

Underwater scatterometer have been employed to show that in-situ subsurface organics are very sensitive to depth, but they also require the use of slow moving boats to cover large sample areas. Also, their very entry into the water disturbs the sample it is measuring. The method described above is superior to any employed thus far. It is the simplest of any employed thus far. It will provide accurate characteristic measurements of the return signal $E(z, g)$ as a function of depth z and wavelength g . It will also provide accurate measurements of the relative concentration as a function depth.

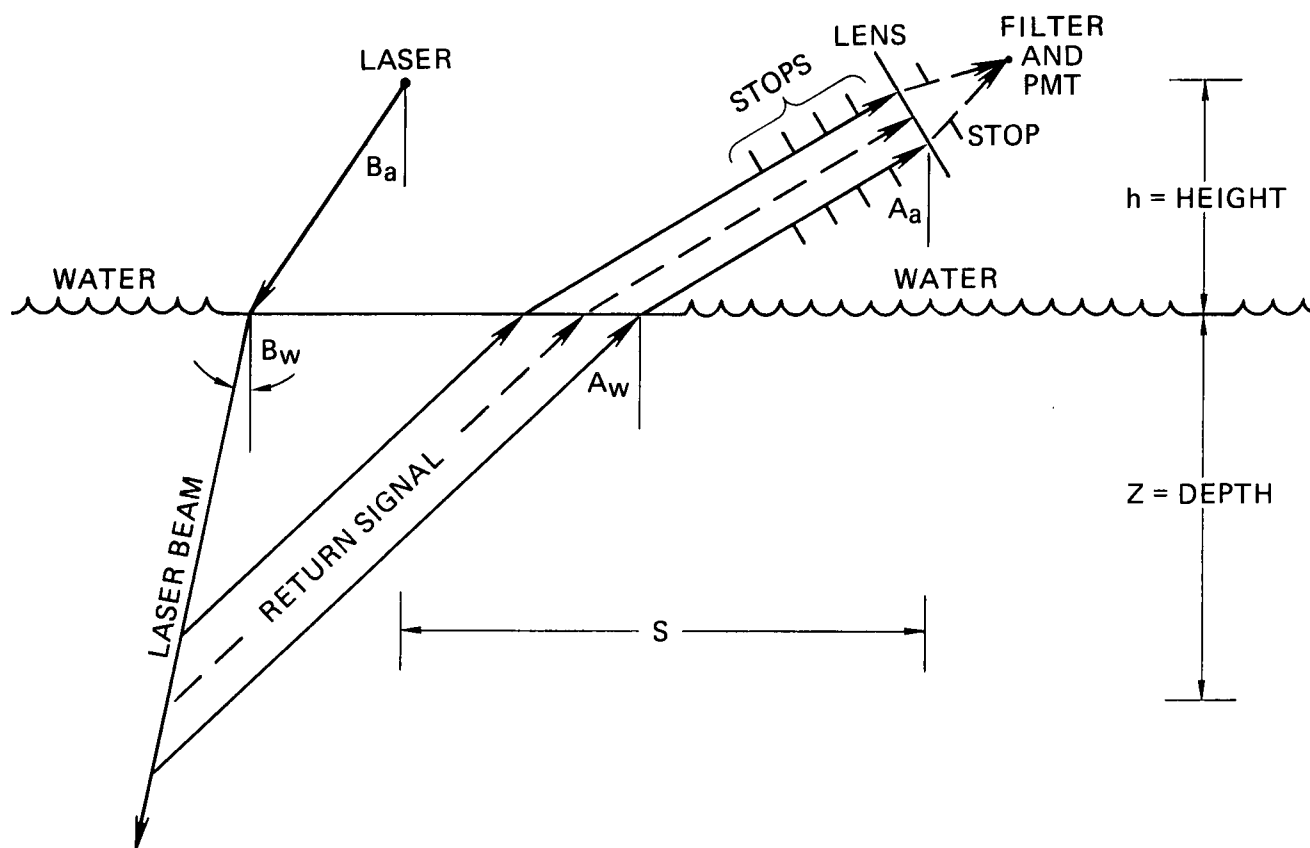


FIGURE 1

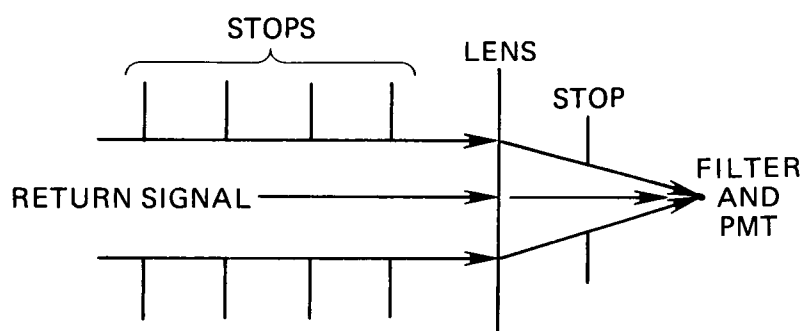


FIGURE 2